

# **A REVIEW OF THE STARFISH GENUS NECTRIA (ASTEROIDEA; GONIASTERIDAE)**

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## **SUMMARY**

The asteroid genus *Nectria* is reviewed in the light of recent collections and a new species, *N. saoria*, from southern Australian seas is described. Notes upon the morphology, ecology and distribution of each species are included together with a key for the genus.

## **INTRODUCTION**

The characteristically Australian genus *Nectria* Gray is widely distributed in southern Australian seas ranging from the Abrolhos Islands in Western Australia to Norah Head on the New South Wales coast. Sladen (1889, p. 318) also reports a specimen from Fiji.

Six species have been described, one of which is endemic to New Zealand. All the species are benthic and limited to shelf waters. Until recently the paucity of specimens has severely impeded a knowledge of the genus with the result that the task of separating the species has not been easy. Clark (1946, p. 85) summarized the knowledge of the genus and gave a key. Recent dredgings, and particularly the advent of the aqualung, have enabled biologists to collect better series of specimens, and to observe their environment and habits. It is now possible to dispel some of the confusion with which the genus has been bedevilled since the time of the early inadequate descriptions of some species.

In this paper the taxonomic relationships between the Australian species are examined and the results of a study of the specific characters for each are given. One new species from South Australia is described and the variation in the other species is discussed. A key is supplied and photographs of typical forms added to make their recognition easier and to assist future workers. The author records his observations upon the ecology and distribution of the species in southern Australian seas.

The collections of the Queensland Museum, Australian Museum, National Museum of Victoria, Hobart Museum, South Australian Museum and Western Australian Museum have been examined and the following abbreviations are used for them respectively: Q.M., A.M., N.M.V., H.M., S.A.M., and W.A.M.

***Nectria ocellifera* (Lamarck)**

*Asterias ocellifera*, Lamarck (1816), p. 553.

*Asterias ocellifera*, Oudart, pl. 1 (1815).

*Goniodiscus ocelliferus*, Muller and Troschel (1842), p. 60.

*Nectria ocellifera*, Dujardin and Hupe (1862), p. 406.

In 1963 and 1964 the *Diamantina* dredged extensively in Western Australian shelf waters between 21° and 33° South Latitude. As a result seven specimens of this little known species were taken, all between 31° and 33° South in 120-200 m.

Although the locality of origin of the type is not known it now seems probable that it was taken in Geographie Bay, Western Australia by Peron and Le Sueur who dredged there in 1801. (Peron 1812, pp. 53, 83.)

For many years writers have been perplexed by the similarity of this species to *N. ocellata* (Sladen 1889, p. 319 and Mortensen 1925, p. 293). Clark (1914, p. 139 and 1916, p. 34) however felt little hesitation in recognizing each species on the basis of the Endeavour specimens of 1912 and the recent material amply confirms his opinion and establishes this as an endemic species of the deeper shelf waters of Western Australia.

There is little difference between the specimens which range in size from juveniles in which  $R = 37$  mm. to adults in which  $R = 61$  mm. and the distinctive characters of the species are well marked. The disk is large and the rays short as indicated by the  $R/r$  ratio which in adults is 2.5, and in juveniles 2.9 to 3. The granulation upon the aboral disk tabulae is unique. The peripheral granules are large, tending to be flattened and form a radiating fringe about the tabula. In several specimens the peripherals protrude obliquely outwards so as to give a saw-toothed appearance to the tabula. The inner granules are quite different in character and are flattened and extremely low, being raised above the tabula by not more than 0.1 mm. They may be circular or somewhat polygonal but not crowded. Pedicellariae are absent. Orally the spines of the adambulacral or oral armature have little tendency to be prismatic. As Oudart's Plate is not available either in the Paris Museum or the British Museum (Nat. Hist.) (pers. comm. A. M. Clark) the species is figured here for the first time.

*Material examined.* W.A.M.: 2 specimens numbered 4914 between Fremantle and Geraldton 100-200 m. W.A.M.: 1 specimen N7 locality unknown; 5 specimens N2-N5 and N8 dredged by H.M.A.S. *Diamantina*

for C.S.I.R.O. between 100-200 m. off Lancelin Island, Fremantle and Cape Naturaliste. A.M.: J.3055 Endeavour 40-200 m., between Geraldton and Cape Naturaliste.

***Nectria ocellata* Perrier**

*Nectria ocellata* Perrier (1876), p. 1.

*Nectria ocellifera* Sladen (1889), p. 319.

There has been much nomenclatural confusion between *N. ocellata* and *N. multispina*. The examination of a good series of specimens from much of the southern coast of Australia has thrown some light on the problem. There are two good species. One is essentially a deep water form having widely separated dorsal tabulae; this is referred to *N. ocellata*. The other is a littoral seastar with close or crowded dorsal tabulae and is referred to *N. multispina*.

Perrier's description of *N. ocellata* (1876) was apparently based upon specimens in the British Museum from Tasmania and Bass Strait. As is discussed later in this paper there is some intergradation between the two species in Tasmanian waters. The specimens examined by Perrier apparently included both intermediates and at least one representative of *N. multispina*. I have seen a photograph of this latter specimen Number 1.8.10 1862 taken by Dr. Mulligan, Tasmania (pers. comm. A. M. Clark). Furthermore, Perrier did not specify a type but it is relatively clear that his description refers primarily to those specimens having widely separated dorsal tabulae. This view is supported by Sladen (1889) and Clark (1914, on p. 140). Sladen's figure is typical of specimens taken along the whole of the southern Australian coast from Bald Island, Western Australia to Norah Head, New South Wales. As the only real differences between the two species relate to the dorsal tabulae the following description is given of *N. ocellata*.

The dorsal tabulae are more or less the same size, circular and well-spaced, so that the distance between them is rarely less than the diameter of a single tabula. The tabulae are usually cylindrical although in some specimens the flaring outwards of the peripheral granules causes them to appear rather hour-glass shaped; they are covered with small hemispherical sub-equal granules which may be well-spaced or comparatively crowded. In the latter case the granules are vaguely polygonal by mutual pressure. The peripheral granules are generally similar in size and character to the internal granules and are usually elevated somewhat so as to form a crown about the

tabula. They may be flared outwards a little, but this may be an artefact of preservation. The dorsal granulation is not developed nearly as much as in *N. ocellifera* or *N. wilsoni*.

Two specimens (J.6775 and E.5398) both from about 100 m. in eastern Bass Strait are notable for the crowding of the dorsal tabulae and the unusually enlarged central granules on the distal tabulae. The specimens from New South Wales (J.7213 and J.7543) taken in Sydney Harbour show the same peculiarities and the granules of their dorsal tabulae are coarse and in some cases bluntly pointed. The spines and pedicellariae orally are also very coarse and thick. Although there is some resemblance in these respects to *N. wilsoni* comparison of the specimens with that species shows that they are much closer to *N. ocellata*. I do not think that the differences shown by these specimens are sufficient to justify specific recognition. Examination of specimens of *N. ocellata* from Bass Strait and from the eastern Australian coast shows that the species is very variable in the characters referred to and that the specimens from Sydney Harbour represent one extreme of the species' range of variation.

These specimens occur near the northern limits of its geographic range and it may be that the morphological variation reflects the genetic instability of peripheral populations.

Figure 1 shows the range of *N. ocellata* from Bald Island in the Great Australian Bight to Norah Head, New South Wales. There is a record of a juvenile specimen (K.654) from Caloundra, Queensland and a specimen (N.M.V.) is reported to have been taken off Manrilins.

Along the South Australian coast and in the Great Australian Bight the species' depth range is from about 30 m. to 200 m. Little is known of its habitat. However the species appears common at 45 m. in Backstairs Passage, South Australia. Here swift tidal currents sweep over the sea floor comprised of rock and coarse shell-grit beds, where large sponge colonies grow prolifically. Numerous specimens were found upon the sponges on which they appear to feed and others were seen moving across the shell-grit beds. On the seabed specimens blended with their grey background but at the surface they were seen to be a brilliant orange colour with a few dark red markings scattered irregularly over the dorsal surface. Other specimens have been taken at about the same depth on mud or shell-grit beds between Rapid Head and Cape Jervis, St. Vincent Gulf.

On the Victorian and Tasmanian coasts the seastar invades shallow water as specimens are recorded on jetty piles in Victoria and intertidally in southern Tasmania. It is found there on both rocky and sandy bottoms.



FIG. 1

Map showing distribution of the species of *Nectria* around Australia.

In New South Wales the species has been taken occasionally from deep water. Three specimens were taken in Sydney Harbour on rocky bottom but I am informed by skindivers there that the species is quite rare in shallow water.

*Material examined.* A.M. (Tas. & Vic.): J.5015, E.5398, J.6775, J.5013, J.5424, E.5362, E.5361, J.5867, J.5424 (3 specimens), J.1202; (N.S.W.), J.7213, J.7543, J.3466; Gt. Aust. Bight (S.A.), J.1614. N.M.V.: 2 specimens Westernport dredged 22.11.1911; 1 specimen Portsea Pier; E.294—(2 spec.) Endeavour. W.A.M.: No. 9676 Bald Is. No. 46 6-62 55-60 m. Gt. Aust. Bight (D. L. Serventy). Q.M.:

G. 4; E.294 off Devonport. H.M.: 2 specimens without label R/r = 64/27 and 59/22 latter intermediate with *multispina*; H99. S.A.M.: (11 specimens). K654 Caloundra, Qld. K585, K596, and K604 from Cape Jervis (collected by the author).

### *Nectria multispina* Clark

*Nectria multispina* Clark (1928), p. 375.

The existence of this species was probably first noted by Moebius (1859). An examination of the description and figures of *Chaetaster munitus* Moebius 1859 strongly suggests that it is identical with *N. multispina*. Unfortunately the question cannot be conclusively settled as the type specimen in the Kiel Museum was destroyed during World War II (pers. comm. Dr. P. Ohm, Zoologisches Institut und Museum der Universität, Kiel). The locality of the type (Öst Indien) is vague enough to include the whole of the Australian region.

Fisher (1911 p. 163) also appears to have seen a specimen of the species from Westernport, Victoria, but was uncertain as to its specific identity.

It is thought worth while to give a detailed description of the appearance and granulation of the dorsal tabulae to distinguish it from *N. ocellata* with which it has frequently been confused.

The tabulae on the disk and proximally on the ray are elevated, convex and generally lie close together so as to be more or less polygonal through mutual pressure. In some they are so closely packed that papular areas cannot be seen but in other specimens the tabulae are quite rounded and spaced apart. Where the spaces between tabulae exceed one-half of the diameter of a tabulae or thereabouts the specimen is regarded as being intermediate with *N. ocellata*. The granules on the tabulae are polygonal, usually set close together and flattened on top. Some diversity exists in their relative size; for the most part the granules are sub-equal but in some the central 3 to 4 are considerably enlarged. In a few specimens

### FIG. 2

Upper Left. Dorsal view of holotype of *Nectria saoria*.

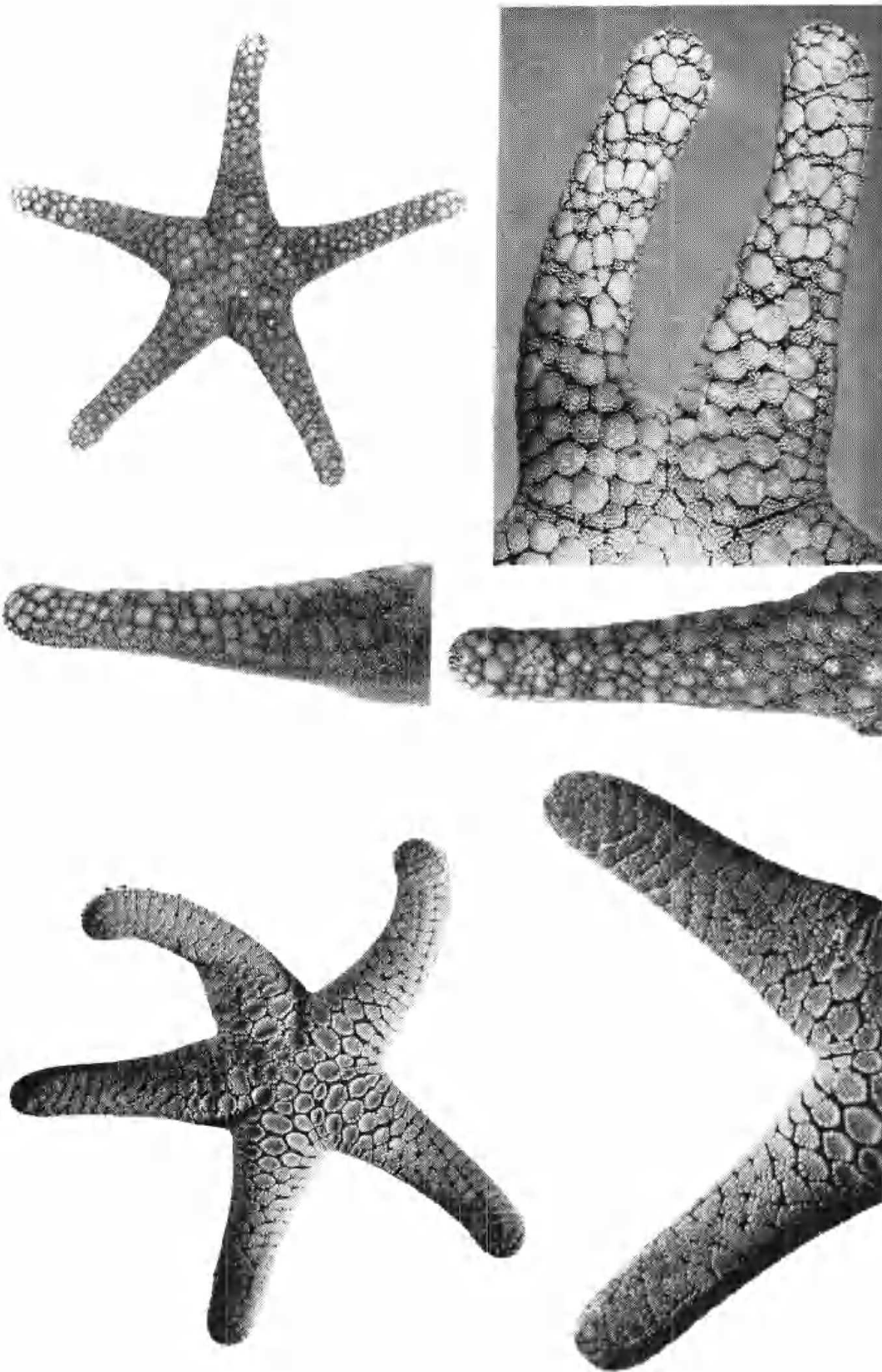
Upper Right. Enlarged dorsal view of portion of paratype of *Nectria saoria* W.A.M. Nod. S-64 from Hamelin Bay Leeuwin.

Centre Left. Lateral view of ray of holotype of *Nectria saoria*.

Centre Right. Enlarged dorsal view of ray of holotype of *Nectria saoria*.

Lower Left. Dorsal view of specimen Nod. K. 615 of *Nectria macrobrachia* taken at West Island Encounter Bay at 7m. R/r is 34/11mm.

Lower Right. Enlarged dorsal view of rays of specimen Nod. K615 of *Nectria macrobrachia*.





mostly those considered intermediate with *N. ocellata* the granules are not crowded but separated by small gaps from their neighbours so that the granules are not sharply polygonal but rounded at the vertices. The peripheral granules apart from being somewhat smaller are not different in character and shape from the inner granules. Sometimes they form a distinct fringe about the tabula but at other times they are closely appressed to the other granules as in the figure of Mortensen (1925) p. 293 fig. 9b of *N. pedicelligera*. Frequently their ends are truncate thus giving to the granulation a neat, clipped appearance. Other differences of a statistical nature are shown in table 1.

As some differences were observed between the specimens taken in St. Vincent and Spencer Gulfs and those taken from the more exposed coasts of South Australia, the series for each is analysed separately. Gulf populations show very little diversity in morphology but specimens from exposed coasts show considerable variation in the characters set out in table 2 and tend to have larger dorsal tabulae and coarser granules than gulf specimens. The number of specimens intermediate with *N. ocellata* is not great but their examination leaves little doubt that some hybridization occurs on these coasts between *N. multispina* and *N. ocellata*.

Specimens from the Gulfs are invariably a wine red in colour dorsally with some of the prominent tabulae at the base of the arms frequently darker in colour; below the colour is an orange to bright red. Specimens from exposed coasts show much diversity in colour ranging from yellow or orange to a very dark red; their colour below is usually a lighter shade of that dorsally. Specimens from depths exceeding 15 m. are usually found to be lighter in colour than those from shallower water.

The Victorian specimens show the same variability as the South Australian specimens from exposed coasts.

A few of the specimens which I have seen from Tasmania and in particular from D'Entrecasteaux Channel cause difficulty as they show varying degrees of intermediacy between *N. ocellata* and *N. multispina*.

#### FIG. 3

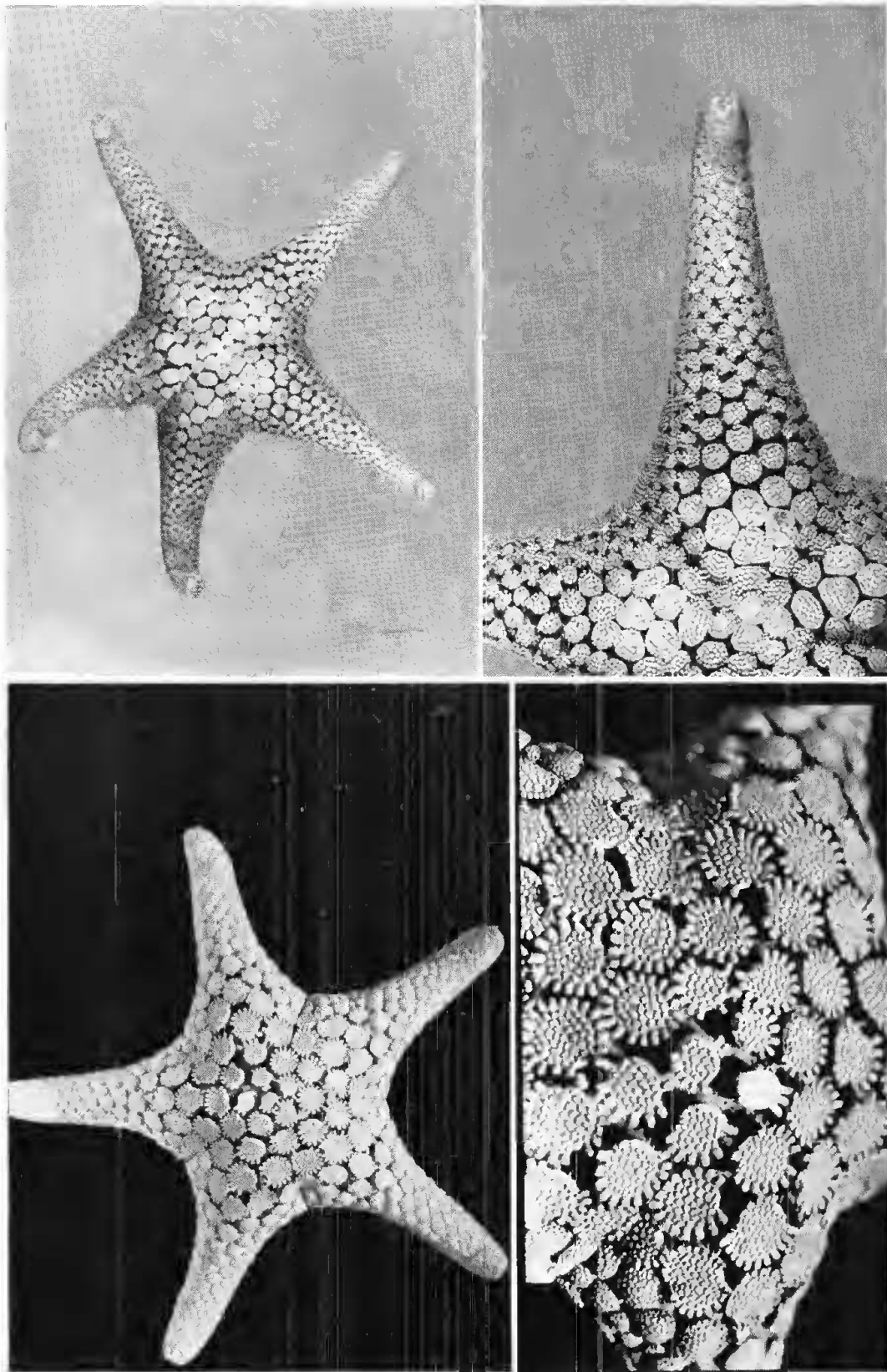
Upper Left. Dorsal view of specimen of *Nectria multispina* Nod. K594 taken at Christies Beach, St. Vincent Gulf at 6m. R/r is 71/23mm.

Upper Right. Enlarged dorsal view of same specimen of *Nectria multispina*.

Lower Left. Dorsal view of specimen of *Nectria ocellifera* N7 & R/r is 69/23mm. Photo. Dr. E. P. Hodgkin.

Lower Right. Enlarged view of dorsal disk tabulae of same specimen of *Nectria ocellifera*.





The species is characteristically a shallow water seastar and is found only on rocky substrate. In St. Vincent and Spencer Gulfs it is very common on shallow water reefs on their eastern margins where it ranges bathymetrically from about low water to 15 m. It is most frequently seen in the open amongst the brown algae which characterize such areas. The starfish is usually taken feeding on rock-encrusting organisms but its diet also includes small shellfish and occasionally red algae.

On the exposed coast the seastar's habitat is somewhat different; there it seeks shelter from the force of the swell so that in exposed locations it is found in deeper water between 10 and 30 m. in caves and crevices where it feeds on a variety of encrusting bryozoa, sponges and ascidians. Where there is some protection from the swell it may be found in shallower water between 5 and 15 m. among the red algae upon which it is sometimes found feeding. The species is by no means as prolific on the open coast as in the Gulfs.

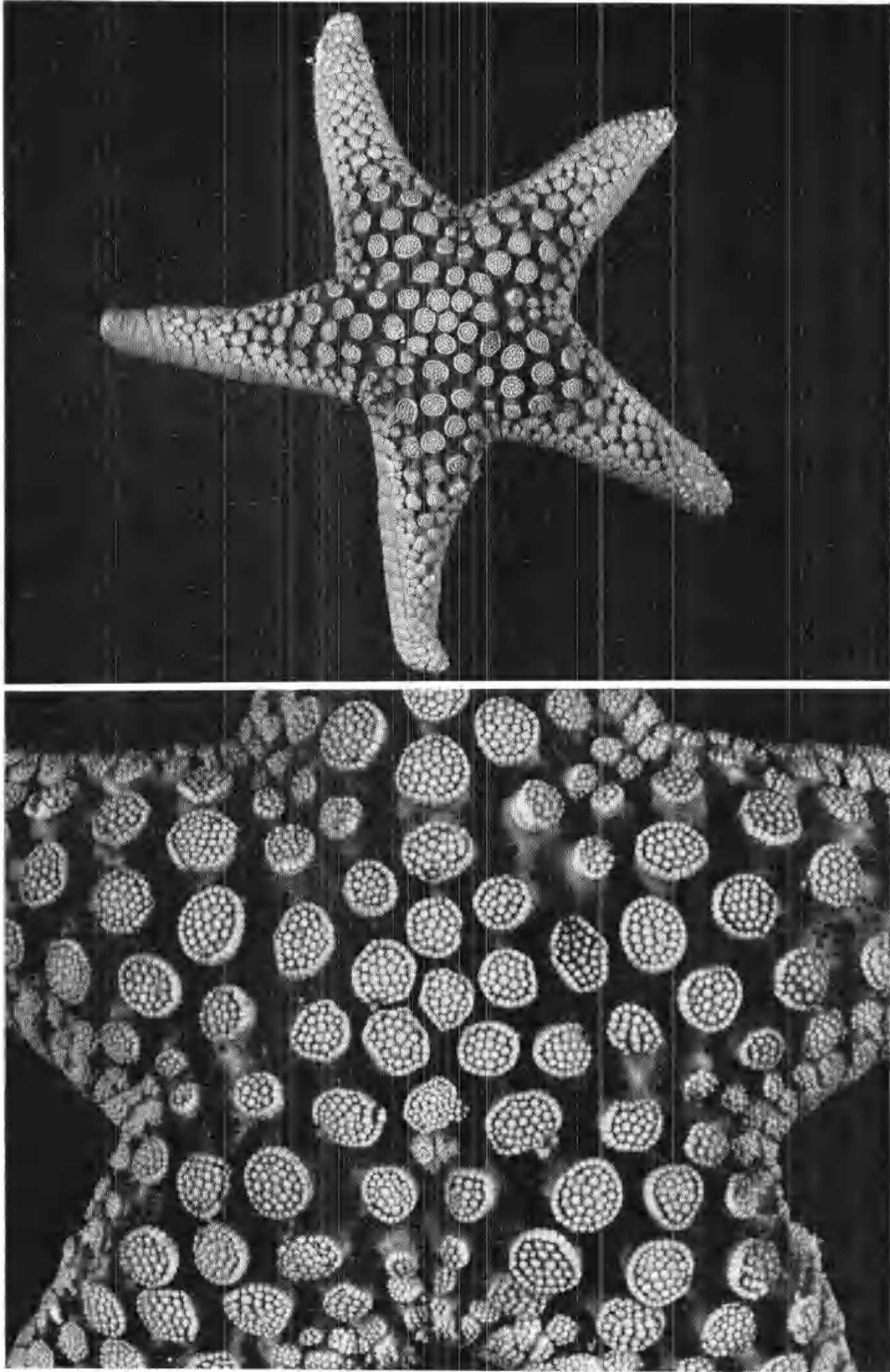
The known range of the species is from Spencer Gulf eastwards and along the Victorian and Tasmanian coasts. It has not been reported from New South Wales waters.

*Discussion:* The inter-relationships of *N. ocellata* and *N. multispina* are of some interest.

On the South Australian coasts *N. ocellata* is typically an inhabitant of deeper water and appears to be excluded from the Gulfs and the littoral fringe of the southern coast. *Nectria multispina* on the other hand does not occur in deeper water but along the coastal fringe and in the Gulfs. It is considered that the maintenance of the two species is well justified on the existing evidence. If the morphological differences in *N. ocellata* and *N. multispina* were ecologically determined then much more intermediacy would be expected than does in fact occur. Furthermore in the few localities in South Australia where overlap occurs the correlation between phenotype and habitat is not invariable. It is thought that the ecological requirements of the two species are sufficiently different to separate them micro-geographically with a probable zone of overlap occurring on the open coast. The greater variability of *N. multispina* and the incidence of specimens intermediate with *N. ocellata* on open coasts suggests that

FIG. 4

Dorsal view of specimen of *Nectria ocellata* from Westernport Victoria taken 22/11/1911 lodged in N.M.V. R/r is 57/22mm, and enlarged view of dorsal disk tabulae of same specimen.



whilst some gene flow takes place between the species in areas of overlap, it is negligible in the gulfs where ecological differences are reinforced by geographical separation.

The concurrence of both species on Victorian and Tasmanian coasts in similar habitats in shallow water and the degree of intergradation observed there suggests a similar reduction of isolating mechanisms between the species with some consequential interbreeding.

*Material examined.* A.M.: J.6752, J.6776, J.4553. N.M.V.: 3 specimens Cape Paterson Vic.; 1 specimen Torquay, Coll. D. Watson; 1 specimen Flat Rocks Inverloch 27.1.64; 1 specimen Waratah Bay, Coll. J. H. McPherson 1951. Q.M.: G.2225 St. Vincent Gulf. H.M.: H.96, H.97. S.A.M. (82 specimens): K19, K589, K590, K592-595, K624, K655, K662-667, K669. (Collected by the author.)

### ***Nectria wilsoni* Shepherd and Hodgkin**

*Nectria wilsoni* Shepherd and Hodgkin 1966, p. 119.

I have seen nine more specimens of this species, one numbered K.51 (S.A.M.) taken at Bunbury, Western Australia and eight numbered 1-66 (W.A.M.) taken at Two People Bay, Western Australia. Some of the specimens are juveniles the smallest having R/r = 37/12 mm, but all of them are within the range of variability of the species. The known distribution of the species as now extended is from Beagle Island (29° 50' South Latitude) on the Western Australian coast to Two People Bay in the Great Australian Bight.

### ***Nectria macrobrachia* Clark**

*Nectria macrobrachia* Clark (1923), p. 236.

The species shows little variation throughout its range. In all specimens the arms are relatively long, the tabulae are low and always excessively crowded together and usually appear rather concave in their general facies. The inner granules are invariably irregular, polygonal, closely packed, very low, and usually subequal, in size. The peripheral granules are distinctly larger than the inner granules, and are elevated and set closely together so as to form a crown around the tabula.

The two specimens taken off Port Gregory, Western Australia are notable as they are atypical in the shape of the peripheral granules which are flared and radiate outwards and are quite different in character from the inner granules. These show marked affinities with *N. ocellifera*.



Pedicellariae are generally absent; only on one specimen (from Dunsborough, Western Australia) were any detected. In that case it was three-pronged, thick at base, stumpy and rounded at the top and situate orally behind the mouth plate. On many specimens a number of adjacent oral spines are polygonal and present a flat face to each other; these appear to be capable of performing the function of pedicellariae. The colour is a particularly constant feature; nor is it fugacious as in the other species. It ranges from a light yellow or fawn to a brown-orange or even pink colour and all specimens except some from Western Australia show the very ends of the rays prettily tipped with a darker brown. The South Australian specimens are lighter in colour than those from Western Australia. Frequently the peripheral granules of the dorsal tabulae are paler in colour than the inner granules.

Like other members of the genus this species is an inhabitant of rocky substrate and feeds similarly upon bryozoan polyps, sponges and other encrusting organisms. Bathymetrically it ranges from the intertidal zone down to about 350 m. Along the South Australian coast it is abundant on the shallow limestone and granite reefs of southern Yorke and Fleurien Peninsulas on exposed coasts. It is equally at home at depths of 50 m. in Backstairs Passage living on sponge colonies. The species has not been recorded from the calmer waters of the two gulfs.

*Material examined.* W.A.M.: 1 specimen Hall Bank Fremantle 1.2.63 R/r 54/15, B.R.W.: 1 specimen Dunsborough on rock 20 m. 15.4.63, B.R.W.: 1 specimen Rottnest 26 m. Duffield Ridge 18.4.59; 2 specimens Pt. Gregory 120 m. Stn. DM/1/40/64, C.S.I.R.O.; 1 specimen Dunsborough Limestone reef 55' 15.4.63; 1 specimen Dunsborough 3 miles offshore limestone 25/2/63; 1 specimen Dunsborough 18.4.60 4 miles offshore B.R.W. rocky bottom Geographie Bay at 18 m. S.A.M.: K586 (1 specimen) Cape Jervis at 36 m.; K615 (3 specimens) West Island at 10 m.; K660 (11 specimens) Pondelowie Bay, Yorke Peninsula at 5 m. (all collected by the author). N.M.V.: 1 specimen Cape Schank 8/6/61.

***Nectria saoria* n. sp.**

*Diagnosis:* Disk small, arms long and tapering. Plates on aboral surface of disk form low paxilliform tabulae very crowded and covered with small polygonal granules. Distally aboral arm tabulae low and crowded very variable in size but similar in shape and appearance to other aboral tabulae. Papulae are common on the distal part of the arm and occur intermarginally.

Superficially the species resembles *N. multispina* but differs from it and other members of the genus in the extreme crowding of the aboral tabulae, which are invariably polygonal through mutual pressure, and in the similarity in structure and appearance between the distal tabulae of the rays and those of the disk. The other species (apart from *N. macrobrachia*) show quite marked differences between the disk and distal arm tabulae, and there are few or no papulae distally or intermarginally.

*Description of holotype:* Rays 5. R/r is 56/14 mm.  $R = 4r$ . Br is 18 mm. at base, 11 mm. at the middle and 8 mm. near the tip of the ray. Disk relatively small, a little elevated; rays narrow, rounded somewhat raised proximally and terete for distal half. Aboral plates form convex tabulae of rather smooth appearance, more or less irregularly polygonal, those on the disk near base of arms being larger (3.4 mm. across) and those distally 2-3 mm. across.

Tabulae very crowded and covered by coat of low slightly convex, closely appressed polygonal granules. On a plate 4 mm. across there are 20-30 inner granules among which there may be considerable disparity in size, the centre ones sometimes twice as large being up to 1 mm. across. Peripherally, there are from 30-40 distinctly smaller granules about 0.2 mm. across and sometimes flared a little to form a fringe and often giving a "furry" appearance to the dorsal surface. Plates on distal part of ray covered by similar if slightly smaller granules.

Papulae emerge between the aboral tabulae in groups of from 5-15. They are more frequent on disk and proximally on ray than distally on ray, and are present between marginal plates.

Madreporite small and inconspicuous, about 2 mm. across midway between centrum and margin.

Marginal plates distinct proximally but distally become crowded and difficult to distinguish from surrounding plates; about 24-26 in each series, proximally twice as high as long; midway along ray squarish and flat; distally smaller convex and irregular. All are covered with a uniform coat of small polygonal granules which tend to be individually distinct and rounded.

Actino-lateral areas small, plates crowded with low coarse prismatic granules close enough to obscure the outlines of individual plates.

Adambulacral plates about 45, each with three furrow spines, rarely two, subequal prismatic and blunt. Proximally furrow spines 3 mm. long and 0.3 mm. across. On the surface of each plate five or

six thick short and prismatic sub-ambulacral spines; the three longest of these adjoin the furrow spines and the remaining two or three behind resembling the prismatic granules on the first series of actino-laterals.

Some pedicellariae on aboral tabulae nestling under marginal granules and comprising three to four slightly curved flattened spines. There are none orally.

Oral plates with six or seven thick prismatic spines, the innermost stoutest; on surface of each plate there are eight shorter and stouter spines and distally a group of 2-4 short, thick, granuliform spines.

*Material examined.* The holotype (K670) was taken at 10 m. on a submerged limestone reef between Wright Is. and The Bluff, Encounter Bay. Twelve specimens are designated paratypes but show no significant differences from the type. Four of them (K628) are from the same reef, 4 specimens (K627) from West Island, Encounter Bay, 2 specimens off Wright Island Encounter Bay and one (K658) taken between Thistle and Hopkins Islands, Spencer Gulf on a limestone reef at 6 m. All specimens were taken by the author whilst diving. The other paratype (No. 8-64) from Hamelin Bay, Leeuwin, is lodged in the Western Australian Museum.

The specimens were all a bright rose-red colour in life. The skin of the papular areas aborally was black and the papulae protruded between the tabulae, so that the tabulae appeared to be outlined prettily in black. The colouration is constant and quite different from any other species of the genus. In preserved specimens the papular areas are concealed under the aboral tabulae.

The habitat of the species is restricted to rocky reefs on exposed coasts where it is found down to about 20 m. It feeds on rock-encrusting organisms particularly colonial ascidians on which a slight groove may be seen where it has grazed the surface. It also feeds on lithothamnia and other red algae; I have observed specimens engulf fronds of the delicate red alga *Neomonospora griffithsioides* Harvey leaving behind only the colourless cellular structure.

There is no doubt as to the generic location of the species; in dimensions, shape and habitat it is very similar to *N. macrobrachia* whereas the granulation of the dorsal tabulae resembles that of *N. multispinna*.



There are seven specimens in the Western Australian Museum which are referred to this species.

W.A.M. 6-64 R = 67 mm. 60' near Pilot Rock Yallingup.

W.A.M. 7-64 R = 67.5 mm. near Pilot Rock Yallingup.

W.A.M. 8-64 R = 59 mm. Hamelin Bay, Leeuwin. Jetty Piles.

W.A.M. 4-62 R = 57 mm. North side of North Twin Peak Is. Recherche Archipelago. Intertidal granite. Colour pinkish-red.

W.A.M. 5-64 R = 45 mm. 16 m. 3 miles off Dunsborough, Geographie Bay.

W.A.M. 5-62 R = 18 mm. 1 mile east of Frenchman's Bay, Albany intertidal pool.

Dr. E. P. Hodgkin has also two specimens from Cheyne Beach near Albany taken inter-tidally and one specimen from Shoreham near Melbourne, Victoria.

From the material before me the species has a distribution from South Western Australia to Port Phillip Bay, Victoria.

### ***Nectria pedicelligera* Mortensen**

*Nectria pedicelligera* Mortensen (1925), p. 291.

I have not seen any specimens of this species. However the description of the type and the figures shown do not disclose any real difference from *N. multispina*. The pedicellariae shown by Mortensen are not an uncommon feature in the genus. The species must be retained awaiting examination of specimens.

### REMARKS ON THE VALUE OF CERTAIN CHARACTERS

The results of morphological data obtained from each specimen are summarized in table 1.

*R/r Ratio.* The differences between species may be statistically significant. In three species (*N. saoria*, *N. macrobrachia* and *N. ocellifera*) the relative size of disk and arms is constant and a reliable character but is extremely variable in the other species.

*Dorsal tabulae.* The granular covering of the tabulae on the disk and at the base of the rays is of value diagnostically. The shape and appearance of the granules is a constant feature for any species, although the size of the granules on a tabulae shows some variation even for a single specimen. For this reason only the observed range in the number of granules on the prominent dorsal tabulae at the base

of the ray is given. In those species where the number of granules is relatively few the grains are usually large hemispherical and well-spaced.

The granular covering of the plates distally on the rays is also of significance. In two species (*N. saoria* and *N. macrobrachia*) they are very similar to the proximal tabulae but in the other species they are low and covered by a uniform coating of small grains so that it is difficult to distinguish individual tabulae.

*Papulae.* The presence of numerous papulae emerging between the distal plates of *N. saoria* and *N. macrobrachia* is a useful diagnostic character. In the other species papulae are rare or wanting beyond the proximal half of the ray.

*Oral spines.* Certain statistical differences are noted in the number of furrow spines and the spines on the mouth plates. Sometimes the number of spines on a plate vary between arms, and in such cases that number is adopted which is predominant in the specimen for the purposes of the table.

*Pedicellariae.* Apart from the two species where they are rare or absent the occurrence or type of pedicellariae has little significance. They may be entirely absent or may occur dorsally beneath the tabulae or on the oral side or both. They usually comprise from three to six fine spines bent inwards at the tip but sometimes there are two to three short thick bluntly pointed component spines. Where present dorsally they are to be found on the tabular shaft (as in Mortensen's fig. 9a (1925) p. 293) and orally either on the mouth plate or in the series behind the furrow spines. Occasionally they are seen in the oral intermediate areas.

*Marginal Plates.* The number of marginal plates depends largely upon the length of the ray. *N. ocellifera* having shorter rays has considerably fewer plates than the other species. The character is of little use.

KEY TO THE SPECIES OF *NECTRIA*

1. Disk small, rays long and tapering R/r is 3 to 4.  
 Disk tabulae low and crowded—dorsal tabulae distally on rays similar in form and granulation to those proximally. Papulae emerge between tabulae throughout length of ray . . . . . 2  
 Disk larger. Disk tabulae conspicuously elevated. Tabulae distally on ray low and crowded with different type of granulation usually a cluster of small grains. Papulae rare or wanting distally on ray . . . . . 3
2. Dorsal tabulae crowded, with low closely packed polygonal granules, the peripherals larger and provide a raised margin so that each tabula appears concave. Colour: Pale yellow to orange, the tips of rays darker. Papular areas cannot be seen . . . . . *macrobrachia*  
 Dorsal tabulae convex with covering of tightly packed polygonal granules, the peripherals smallest. Colour bright red, papular areas black . . . . . *saoria*
3. Granules of dorsal tabulae very low (elevated about 0.1 mm.) irregular and flat. Peripheral granules are large and scale-like and form a regular radiating marginal fringe . . . . . *ocellifera*  
 Granules of dorsal tabulae not low, but hemispherical or polygonal, 0.5 to 1 mm. high . . . . . 4
4. Distal tabulae with a large dominant central hemispherical granule, surrounded by a ring of smaller grains. Disk tabulae with large protuberant well-spaced dome-shaped granules . . . . . *wilsoni*  
 Distal tabulae comprised of group of small crowded grains, sub-equal in size . . . . . 5
5. Dorsal tabulae elevated, well-spaced, with covering of hemispherical granules, the peripherals forming a radiating fringe . . . . . *ocellata*  
 Dorsal tabulae elevated and crowded and covered with closely packed polygonal flat-topped granules . . . . . *multispina*

TABLE 1  
Morphological characteristics of species of the genus *Nectria*

	<i>ocellifera</i>	<i>ocellata</i>	<i>multispina</i>	<i>wilsoni</i>	<i>saoria</i>	<i>macrobrachia</i>
Number of specimens examined ...	9	23	82	17	21	24
Maximum R observed (in mm.) .....	61	121	98	110	76	62
R/r—						
Range .....	2.5-3.0	2.1-3.5	2.7-3.7	2.6-3.5	3.0-4.0	3.2-4.0
Mean $\pm$ 1 S.D.	2.7 $\pm$ 0.22	2.8 $\pm$ 0.41	3.2 $\pm$ 0.23	3.1 $\pm$ 0.30	3.5 $\pm$ 0.19	3.6 $\pm$ 0.22
Range in number of granules on large tabulae midradially at base of ray	50-75	35-70	50-105	20-80	35-75	60-160
Furrow spines..	3 4 62% 38%	3 4 5 62% 33% 5%	3 4 5 84% 14% 2%	2 3 12% 88%	2 3 4 26% 70% 4%	2 3 16% 84%
Spines on each proximal margin of mouth plate	5 6 7 17% 50% 33% Absent	6 7 8 9 26% 22% 39% 13% Present	6 7 8 9 22% 53% 22% 3% Present	5 6 7 7% 55% 38% Present	5 6 7 10% 67% 20% Absent	4 5 6 7 10% 67% 20% 3%
Pedicellariae... Supero-marginal plates .....	15-22	25-30	20-30	20-28	22-28	20-25

TABLE 2

Morphological differences between specimens of *N. multispina* taken in St. Vincent and Spencer Gulfs and on exposed coasts.

	Gulf Specimens			Exposed Coast Specimens		
Specimens examined.....	43			39		
R/r—						
Range .....	2.8–3.3			2.8–3.8		
Mean R/r $\pm$ 1 S.D. ....	3.1 $\pm$ 0.14			3.3 $\pm$ 0.28		
Oral spines on each side of mouth plate	6	7	8	6	7	8
	15%	65%	20%	31%	47%	19%
Furrow spines .....	3	4		3	4	5
	92%	8%		73%	23%	4%

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NOTE.—Unfortunately I was not able to see Miss A. M. Clark's paper on the Echinoderms of the Port Phillip Survey (Mem. Nat. Mus. Vict., No. 27, p. 298) before this paper went to press. As some confusion between the species is evident in her work I add the following comments upon table 3 at p. 315.

The first thirteen specimens are probably *N. ocellata* although two of them (90.5.7443 and 62.7.952) may be intermediate with *N. multispina*. The next three specimens W.A.M. 18.59; 19.59; and 2.62) are *N. wilsoni* (one of them is figured in pl. 1). The next four specimens are all well within the range of variation of *N. multispina* and must be referred to that species (except the type of *N. pedicelligera* upon which judgment is reserved). I base this conclusion upon the data supplied and the figures of two of the specimens which are in print.

Of the last group of specimens, five (W.A.M. 5.62; 4.62; and 1.62 and the two specimens of Dr. Hodgkin from Rottnest Island), are *N. saoria* and the remainder are *N. multispina*.